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UNITED STATES SPECIES OF FUIRENA. F. V. Coville.

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Revision of the United States species of the genus *Fuirena*.

BY FREDERICK V. COVILLE.

Plate XCVIII.

The various forms of *Fuirena* grouped under the name *F. squarrosa*, Mx., show much variation in both external and internal characters. The external variations are confined commonly to those of size, hairiness, and inflorescence. The height varies from 5 cm. to 90 cm.

Hairiness of the leaves, stem, and sheaths seemed at first to form the basis of good varietal distinctions, but a careful comparison of specimens shows that there is sometimes wide variation within the limits of a variety. I am inclined to believe that these differences may be due largely to individual environment. They certainly are not in all cases co-ordinate with other well defined characters.

The width of the leaves varies, in the specimens that I have examined, from 1 mm. to 7 mm. according to the size of the plant. The inflorescence varies from a single spike to one or a few several-spiked heads. The internal variations noted are in the length of the stipe of the achenium, the length and roughness of the bristles, and several variations in the perianth-scales.

The achenium may have a stipe equal to its own length, or may be nearly sessile. The bristles are sometimes shorter than the stipe of the achenium, when they are usually smooth; or they may equal the achenium, or even greatly exceed it. In these latter cases they are retrorsely barbed.

The perianth scales have a stalk reaching to about the base or middle of the achenium, and there expanding into a blade (usually referred to as the scale). The scale varies in form from narrowly oblong with acute apex and base, to broadly oblong with obtuse apex and base, and deltoid ovate with acute apex and cordate or truncate base. It varies also much in thickness,

that part which lies above the middle of the achenium being spongy, thickened and plump; in mature specimens the lower portion, by compression against the achenium, being thin and showing three, or sometimes only one, nerve. In immature specimens the scales are not thick and plump above but of nearly the same leathery texture throughout, the nerves traceable to the apex. The middle nerve may end in a mere apiculation, in some cases wanting, or may be produced into a short blunt point or long barbed awn. And in some cases this awn may arise on the back of the scale slightly below the apex.

While making an examination of the forms that have been grouped under *F. squarrosa* it seemed desirable to include as well our other entirely distinct species, *F. scirpoidea*; and as a result the following revision of the species of *Fuirena* of the United States is presented.

The localities given after each species and variety were taken (except in one case which is indicated) from actual specimens examined by the writer. These were in the herbaria of Columbia College, Harvard University, Cornell University, Academy of Natural Sciences of Philadelphia, William M. Canby, Isaac C. Martindale, John Donnell Smith, and the National Herbarium; and thanks are due to these three gentlemen, to Dr. Sereno Watson, Dr. N. L. Britton, Prof. William R. Dudley and John H. Redfield, for their kindness in facilitating the work.

To Dr. Britton I am especially indebted for notes from Mr. C. B. Clarke of Kew, and for many valuable suggestions. The specimens in the Shaw herbarium were examined, but by an oversight the localities are not included.

FUIRENA.

Rottboell, Descr. et Icon. Pl. p. 70 (1773).

Inflorescence in terminal and axillary heads of spikelets, the axillary ones sometimes wanting, and the terminal one reduced even to a single spikelet. Spikelets many-flowered. Glumes imbricated on all sides, aristate or mucronate, the lowest one or two empty. Flowers hermaphrodite. Perianth-scales three, not conduplicate, commonly stipitate, membranaceous or thickened, in the American species with as many bristles alternating. Stamens three. Style single, slender, not thickened at the base nor

articulated with the ovary, deciduous. Stigmas three, slender. Achenium about as broad as long, sharply and equally triquetrous, mucronate.

KEY TO THE SPECIES AND VARIETIES.

- a.* Leaves reduced to bladeless sheaths. *F. scirpoidea.*
- aa.* Leaves with well-developed blades. (*b.*)
 - b.* Awn arising abruptly from the back of the perianth-scale, just below its apex. *F. simplex.*
 - bb.* Awn when present borne on the apex of the perianth-scale, which tapers into it. (*c.*)
 - c.* Bristles reaching at least to the middle of the achenium, retrorsely barbed. (*d.*)
 - d.* Perianth-scales narrowly to broadly oblong with a slender awn tapering to a minute point. *F. squarrosa.*
 - dd.* Perianth-scales rhomboidal or deltoid-ovate with a thick short awn or point. *F. squarrosa* var. *hispida.*
 - cc.* Bristles not exceeding the stipe of the achenium, smooth. Perianth-scales awnless or with a mere apiculation. *F. squarrosa* var. *breviseta.*

FUIRENA SCIRPOIDEA.

Rhizome conspicuous, stout, the stems arising from it singly at frequent intervals. Stems slender, about 20-40 cm. in height, unbranched, terminated by 1-3 spikelets. Sheaths 2 cm. long or less, loose, acute, bladeless. Glumes mucronate, the points appressed. Achenium sessile or nearly so by a narrow base. Bristles sometimes reaching the apex of the achenium and retrorsely barbed, sometimes nearly obsolete. Scales orbicular-oblong, obtuse at the apex or nearly apiculate, minutely scabrous along the upper margin.

Michaux, Fl. Bor.-Amer. i. p. 37, t. 7 (1803); and other authors. *Vaginaria Richardi*, Pers. Syn. Pl. i. p. 70 (1805); and other authors.

This plant is very distinct from the other species and shows little variation. The structure of the fruit is very similar to that of *F. squarrosa* var. *breviseta*, the bristles being usually longer and barbed, and the stipe of the achenium and the stalks of the scales shorter.

Georgia (Leconte). Florida (Rugel, Keeler); Miami (Garber); Duval County (Curtiss); Lake Monroe (Garber); St. Augustine (Canby); Apalachicola (Chapman, Saurman); Jacksonville (Curtiss No. 3067). Alabama; Mobile (Mohr). Louisiana; below New Orleans on the Mississippi (Langlois); New Orleans (Ingalls).

FUIRENA SIMPLEX.

Rhizomes usually wanting, and stems tufted. Leaves with well developed, flat, grass-like blades. Glumes with a long squarrose or recurved awn. Achenium nearly sessile. Bristles reaching about to the apex of the achenium, retrorsely barbed. Scale-stalks reaching to the base or middle of the achenium. Scales ovate-oblong, obtuse at the base, with a tendency to become cordate, unusually notched at the obtuse apex. Awn slender, commonly smooth, occasionally retrorsely barbed, sometimes fully as long as the body of the scale, sometimes short and minute, arising abruptly from the back of the scale just below the apex.

Vahl, Enum. Pl. ii. p. 384 (1806). *F. squarrosa*, Torrey Ann. Lyc. Nat. Hist. N. Y. ii. p. 252† (1828).* *F. squarrosa* var. *aristulata*, Torrey, l. c. iii. p. 291 (1836).* *F. Schiedeana*, Kunth, Enum. Pl. ii. p. 183 (1837), fide Boeckeler, Linnaea, xxxvii. p. 105.

Plant 8-50 cm. in height, prevailing smooth, and frequently with short thickish leaves. It differs conspicuously from all the other forms in that the awn rises abruptly, not by a gradual tapering, from the scale. The scales become plump much earlier than in *F. squarrosa*, so that it is seldom possible to find one that shows the nerves, and when mature they are uniformly of a pale buff color, while in *F. squarrosa* they are commonly chestnut-brown.

Arkansas (?) (Long's first expedition, James). Indian Territory (?); Canadian River (Bigelow). Texas (Wright No. 718, 1849; Lindheimer No. 557, 1846); Sutherland Springs (Palmer No. 1335, 1879); Eastern Texas (Hall No. 693, in part, 1872); Fredericksburg (Thurber No. 72, 1850); Dallas (Reverchon No. 562, 1876; Hempstead (collector unknown). New Mexico (Fendler No. 877, 1847). Mexican boundary Survey No. 1523. Herb. Berlandier Texano-Mexicanum No. 3224. Mexico (F. Mueller No. 2147, 1853); Monclova (Palmer No. 1336, 1880).

Forma MACROSTACHYA (Britt.)

F. squarrosa var. *macrostachya*, Britt., Bull. Torr. Bot. Club, xi. p. 87 (1884).* This appears to me to differ from the typical form

* Type specimens examined. † Paper of 1828 read in 1826.

of *F. simplex* scarcely enough to be called a variety, and Dr. Britton agrees with me in this opinion. It is unusually large throughout, with long (about 2 cm.) spikelets. "Valley of the lower Rio Grande" (Buckley).

FUIRENA SQUARROSA.

Rhizomes,* leaves and glumes as described under *F. simplex*.

Achenium nearly sessile. Bristles slender, tapering to the apex, usually exceeding the achenium, retrorsely barbed. Scale-stalk reaching the middle of the achenium. Scale narrowly to broadly oblong, acuminate at both ends, or sometimes abrupt at the base, frequently only one-nerved, tapering into a slender tapering awn usually exceeding the scale and smooth or backwardly barbed.

Michaux, Fl. Bor.-Amer. i. p. 37 (1803). *F. squarrosa*, var. *pumila*, Torrey, Compend. Fl. North. & Mid. States, p. 46 (1826); Ann. Lyc. Nat. Hist. N. Y. iii. p. 291 (1836) †; Fl. N. Y. ii. p. 345 (1843); Gray Man. Bot. (5th Ed.) p. 556, Pl. II. (1867).

Plant usually small, 5-15 cm. in height, but sometimes reaching 60 cm.; mostly smooth except the lower sheaths. Inflorescence sometimes reduced to a single spikelet. The bristles are sometimes twice as long as the stipe and achenium together, and the awn in such cases may equal the scale and its stalk. The barbing of the awn is more conspicuous in these two cases, and wanting in the other extreme. I have seen one depauperate specimen in which both bristles and awns were almost entirely wanting, but the plant undoubtedly belonged here.

* After this paper was completed the writer, while in the field one day, saw for the first time (never having lived in a region in which *Fuirena* grew) a living specimen of *F. squarrosa*, var. *hispida*. While collecting some of the plants he was astonished to find that the rootstocks were plentifully supplied with ovoid tubers about 5 mm. in diameter. It has been learned since that Mr. Theodore Holm of Washington had observed the same organs, and has found the character a constant one. He is preparing a paper on the subject. Not one of the large number of herbarium specimens examined during the work of revision bore a tuber, and I cannot now say whether they are found in any of the other forms. The specimens of the typical form, however, look as if they had never borne tubers.

† The following are given by Torrey in this article as synonyms. I have been unable to examine the descriptions myself. *F. squarrosa* var. *pumila*, Torrey, Fl. North. & Mid. States i. p. 68 (1824); *F. pumila*, Sprengel, Syst. Veg. i. p. 237 (1825); Schultes, Syst. Veg. Mant. iii. p. 546 (1827). *F. Torreyana*, Beck, Bot. North. and Mid. States p. 429 (1833).

By the kindness of Mr. C. B. Clarke of the Royal Herbarium at Kew, I have been able to ascertain that this is the typical form of Michaux's *F. squarrosa*. He writes "Our original specimen of Michaux named *squarrosa* is the slender plant 6 to 8 inches high with fibrous roots, in short=*simplex* Vahl. var. *pumila* sp. Spreng."

Although in the extreme forms of this and var. *hispida* the internal characters are so widely different, a series of connecting forms exists, co-ordinate to some extent with the size of the plant. The original specimen of Michaux as well as Torrey's type of var. *pumila* were small plants, but a series has been made (whose internal characters are identical and whose only external difference is one of size), of which the largest specimen is, as stated above, 60 cm. in height.

Massachusetts; Plymouth (Oakes, Tuckerman); Tewksbury (Torrey, Boott). Rhode Island; Providence (Olney). Long Island, Babylon (Torrey). New Jersey; Monmouth County (Eaton); Cape May (Parker). Delaware; Townsend (Canby). Maryland; Salisbury (Canby). North Carolina; Wilmington (Canby). Florida; Micanopy (Leavenworth); Duval Co. (Curtiss No. 3068, in part). Louisiana (Hale). Michigan, Cass Co. (Wright, specimen in herbarium of Isaac Martindale); "Macomb County, Dr. B. Cooley" (Wheeler & Smith Cat. Pl. Mich. p. 86).

FUIRENA SQUARROSA, MICHX., VAR. BREVISSETA.

Stipe and achenium usually of equal length. Bristles not exceeding the stipe, smooth. Scale-stalks reaching above the middle of the achenium. Scales broadly oblong or orbicular, rounded at the apex, with an abrupt apiculation, minutely scabrous along the upper margin.

F. squarrosa, Chapman, Fl. South. States, p. 514 (1865). *F. squarrosa*, var. α , Torrey Ann. Lyc. Nat. Hist. N. Y. iii. p 290 (1836).*

The plants are usually 10-20 cm. in height, and may be almost smooth throughout, or the sheaths, especially the lower ones, may be densely hirsute, and the leaves and culm sparingly so. The tips of the bristles are usually incurved into the space below the nut. The stipe of the achenium and the stalks of the scales are longer than in any other North American form of the

* Type specimens examined.

genus. The scales in this form do not become so plump as in the typical form, the var. *hispida* and *F. simplex*, and in mature specimens it is frequently necessary to use a compound microscope to see the scabrosity of their upper margins.

I have never had any difficulty in deciding whether a specimen went into var. *hispida* or var. *breviseta*, the distinctive characters, although slight, being clearly defined and constant. Nevertheless these differences seem too inconsequential for the basis of a separate species, and although intermediate forms have not been seen, they may be expected.

North Carolina (McCarthy); Wilmington (Curtiss). South Carolina (Gibbs); Santee Canal (Ravenel). Georgia; Macon (collector not given); Sunbury (Le Conte). Florida (Chapman, Buckley); Duval County (Curtiss No. 3068, in part); Miami (Garber); Apalachicola (Saurman). Alabama (Gates, Mohr). Louisiana (Langlois); New Orleans (Ingalls, Drummond). Eastern Texas, (Neally).

FUIRENA SQUARROSA, var. HISPIDA (Ell.), Chapm.

Stipe a little shorter than the achenium. Bristles reaching about the middle or apex of the achenium, retrorsely barbed down the inner face. Scale-stalks reaching the middle of the achenium. Scales rhomboidal, or deltoid-ovate with cordate or truncate base, tapering into a short thick unbarbed awn or point, usually minutely scabrous along the upper margin and about the base of the awn.

Chapman, Fl. South. States, p. 514 (1865); *F. hispida*, Elliott, Sketch Bot. S. C. & Geor. i. p. 579 (1824).* *F. squarrosa*, Torrey, Compend. Fl. Nor. & Mid. States, p. 45, (1826)†; Gray, Man. Bot. p. 556 (1867). *F. squarrosa*, var. β . Torrey, Ann. Lyc. Nat. Hist. N. Y. iii. p. 291 (1836).* *F. squarrosa*, var. γ , Torrey l. c.* *F. squarrosa*, var. ι , Torrey, Fl. N. Y. ii. p. 345 (1843).

Plant 40-90 cm. in height, usually slender, with long internodes, the sheaths almost always, and the stem and leaves frequently, densely hirsute. A great range of variation in the ap-

* Type specimens examined.

† *F. squarrosa* Torr. Fl. N. & Mid. States i, p. 67 is also probably a synonym. I have been unable to see the work.

pearance of the scales occurs, they when immature being coriaceous and showing the three nerves; but when mature being very plump, apparently nerveless, and sometimes with merely an acute apex in place of the awn. Occasionally some of the fruits in a spike have been found with bristles unbarbed. In fully mature specimens this is especially apt to be true, and at the same time the scabrosity of the apex of the scale becomes lost. Torrey's type of var. *γ* are immature specimens of a form of this variety with scales narrower than usual, and awns longer, the plant varying toward var. *pumila*.

In his description of the species *F. squarrosa* and *F. hispida*, Elliott said very little of the characters of the perianth scales, but characterized the last species principally by its slender habit and hirsute sheaths. *F. squarrosa* was described first and a drawing made.* This drawing is curiously enough an excellent one of the var. *hispida*, afterward described in the appendix as a species, with no reference to the figure. It seems clear, therefore, that Elliott, at that time at least, did not understand the true distinctions of the two forms, basing them on characters usually present but not crucial.

New York; Junius, Seneca County (Sartwell). New Jersey (Eaton, Torrey); Cape May (Martindale). Maryland, Salisbury (Canby, Moyer). Virginia; Prince Edward County (J. D. Smith). District of Columbia (Ward). South Carolina; Aiken (Ravenel). Georgia (Chapman). Kentucky (Short). Florida (Buckley, Chapman). Alabama (Bigelow); Montgomery (McCarthy). Louisiana (Hale). Texas (Lindheimer No. 204, 1843, Nealley); Hempstead (Hall No. 693, in part, 1872).

EXPLANATION OF THE PLATE.

Figures of the fruit, (achenium, bristles, and perianth-scales) of *Fuirena*. All enlarged about ten diameters.

- 1.—*F. scirpoidea*, Michx.
- 2.—*F. simplex*, Vahl.
- 3.—*F. squarrosa*, Michx.
- 4.—*F. squarrosa*, Michx. var. *hispida* (Ell.), Chapm.
- 5.—A scale of the same, as it appears when young.
- 6.—*F. squarrosa*, Michx. var. *breviseta*, Coville.

* Ell. Sk. i. pl. I. fig. 3.